



Department of Development Services

Building Division

4701 W. Russell Road • Las Vegas NV 89118
(702) 455-3000 • Fax (702) 221-0630

Ronald L. Lynn, Director/Building Official

SUBJECT: TG-19-2007 APPROVED CHEMICAL TEST METHODS OF SOILS AND REPORTING CRITERIA

- 1.0 PURPOSE:** This guideline specifies test methods and reporting requirements for the determination of chemical properties of soils. This guideline specifies approval requirements for personnel engaged in the analysis of chemical properties of soils.
- 2.0 SCOPE:** This guideline shall be used on all projects that require determination of chemical testing of soils. Approval for specific elements under this guideline can be requested and approval may be granted on a case-by-case basis.

3.0 ABBREVIATIONS & ACRONYMS:

AAL:	Approved Analytical Laboratory
ACI:	American Concrete Institute
AECII:	Apprentice In Earthwork Construction, Level II
ASTM:	American Society for Testing and Materials
AWWA:	American Water Works Association
CCDDS-BD	Clark County Department of Development Services - Building Division
EPA:	Environmental Protection Agency
IBC:	International Building Code
QAP:	Quality Assurance Plan
SM:	Standard Method Published by AWWA
SOP:	Standard Operating Procedure
TG:	Technical Guideline

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EFFECTIVE DATE: July 20, 2007

Written By	Concurred By	Approved By:
/s/	/s/	/s/
Werner K. Hellmer, P.E. Senior Engineer	John S. Telford, P.E. Principal Engineer	Theodore L. Droessler, P.E. Manager of Engineering

4.0 DEFINITIONS:

For the purpose of this technical guideline, certain terms, phrases, words and their derivatives shall be construed as specified in this section or the Building Administrative Code of Clark County.

Analyst: A person with a minimum of eight years of verifiable, relevant experience; an AA degree in chemistry and four years of verifiable, relevant experience; a BS degree in chemistry and two years of verifiable, relevant experience; or an MS degree in chemistry and one year of verifiable, relevant experience.

Approved Analytical Laboratory: A Quality Assurance Agency engaged in the chemical testing of foundation soils and reporting test results.

Approved Chemical Test Method: The chemical test method listed in this TG as approved for the analysis of a specific chemical element.

Bulk Sample: The sample or samples obtained from on-site soils and imported soils. Soil sample obtained from a blend of on-site native soils and imported soils can be referred to as a bulk sample for the purpose of this TG.

Controlled Copy: Any document for which distribution and status are to be kept current by the issuer.

Equivalent Test Methods to "Approved Chemical Test Methods of Soils": Equivalent test methods, when specifically allowed, refer to Equivalent AWWA Standard Methods, EPA Standard Methods, or ASTM Standard Methods.

Foundation Soils: Soils within the influence zone of a structure's foundation system.

Laboratory Director: A person with a BS degree in chemistry and six years of verifiable, relevant experience; a person with an MS degree in chemistry and four years of verifiable, relevant experience; or a person with a PHD in chemistry and two years of verifiable, relevant experience.

Quality Assurance Plan (QAP): A controlled document that provides procedural basis to insure the production of reliable, accurate, and reproducible test data.

Reduced Sample: A soil sample obtained from a bulk sample by an appropriate reduction technique as specified in this TG.

Soil Sample Fraction: A soil sample, of sufficient size and finer than the No. 10 (2.00-mm) sieve, designated for chemical analysis. This soil sample is obtained by sieving a reduced sample through a No. 10 (2.00-mm) sieve.

Standard Operating Procedure (SOP): Specific quality assurance procedures to be carried out to ensure the overall quality of all laboratory analyses.

Supervising Analyst: A person with a minimum of a BS degree in chemistry and four years of verifiable, relevant experience; a person with an MS degree in chemistry and two years of verifiable, relevant experience.

5.0 REFERENCES:

International Building Code (IBC)

Building Administrative Code of Clark County (BAC)

Southern Nevada Amendments to the IBC

ASTM C 702-98(2003)

ASTM D 75-03

ASTM D 420-98(2003)

ASTM D 2488-06

ASTM D 3740-04a

ASTM E 329-07

ASTM G 57 06

AWWA Standard Methods, 19th edition

Technical Guidelines (TG-15, TG-17)

6.0 RESPONSIBILITIES:

6.1 Clark County Engineering Group

- 6.1.1 Review and disposition applications for listing as an AAL

6.2 Approved Analytical Laboratory

- 6.2.1 Receive soil sample fractions designated for chemical testing from an approved Quality Assurance Agency.
- 6.2.2 Perform chemical testing.
- 6.2.3 Perform required calculations.
- 6.2.4 Prepare a report of test results per Section 7.5

6.3 Approved Quality Assurance Agency

- 6.3.1 Collect, classify, reduce, sieve, and transport soil samples in accordance with Section 7.0.
- 6.3.2 Implement chain-of-custody procedures.
- 6.3.3 Review chemical test results and provide written recommendations regarding adverse soil conditions and durability of construction materials.
- 6.3.4 Establish criteria to invoke remedial actions plans as required by Section 7.6.

7.0 PROCEDURES

7.1 FIELD SAMPLING:

- 7.1.1 Sample location shall be clearly identified and be within the influence zone of the foundation system, including all granular blankets which may be required in a remedial action plan.
- 7.1.2 Sampling shall comply with applicable ASTM Standard Method D 75.
- 7.1.3 Soil sample shall be classified by the Unified Soil Classification System (USCS).
- 7.1.4 Sample collection, reduction, sieving, storage, and transportation to an AAL shall not contaminate or otherwise alter soil chemical properties.
- 7.1.5 Sampling shall be performed by a CCDDS-BD approved Quality Assurance Agency. An inspector approved in special inspection item G-T, G-A or an AEC II(or above) shall perform field soil sampling for chemical testing.

7.2 SOIL SAMPLE REDUCTION

- 7.2.1 Soil sample reduction, to obtain a sample with sufficient volume, shall comply with applicable ASTM Standard Method D 702.
- 7.2.2 Soil sample shall be pulverized as required or applicable.
- 7.2.3 Soil fraction passing through the No. 10 (2.00-mm) sieve shall be used for extraction of an aqueous solution.
- 7.2.4 Except for the process of reducing and sieving specified in 7.2.1 and 7.2.3, respectively, soil sample composition or properties shall not be altered in any manner.
- 7.2.5 Soil fraction prepared in accordance with the above guidelines shall be a minimum of 100 grams AND of sufficient amount to complete determination of all required chemical soil properties. This soil fraction shall be delivered to an AAL for chemical testing.

7.3 SOIL SAMPLE CONDITIONING AND EXTRACTION OF AN AQUEOUS SOLUTION

- 7.3.1 Soil sample fraction prepared in accordance with 7.2 shall be conditioned and prepared, for the required time duration and by mechanical or other means, as required in the approved test method.
- 7.3.2 Extraction of an aqueous solution shall be prepared from the conditioned sample as required in the approved test method.
- 7.3.3 A CCDDS-BD approved Analytical Laboratory shall perform sample conditioning & extraction.

7.4 CHEMICAL TESTING:

- 7.4.1 Chemical testing shall be performed on an aqueous solution extracted as specified in the approved test method.
- 7.4.2 Test Methods shall be as follows, where “x” refers to the method subscript A, B, C, etc. as per the Standard Methods (SM) published by AWWA:
 - 7.4.2.1 **SULFATE**: SM 4500x, or ASTM D516
 - 7.4.2.2 **SODIUM**: SM 3500x, or equivalent test method.
 - 7.4.2.3 **SODIUM SULFATES**: By Calculation from 7.4.2.1 and 7.4.2.2
 - 7.4.2.4 **TOTAL SOLUBLE SALTS (TOTAL SOLUBILITY)**: SM 2540x
 - 7.4.2.5 **SOIL CORROSIVITY**: includes the following tests:
 - 7.4.2.5.1 Soil PH: ASTM G57 or equivalent test method.
 - 7.4.2.5.2 Soil Oxidation Reduction Potential: SM 2580x
 - 7.4.2.5.3 Sodium, Sulfate, Sodium Sulfate, as specified in subsections 7.4.2.1, 7.4.2.2 and 7.4.2.3, respectively.
 - 7.4.2.5.4 Soluble Sulfides: SM 4500x.
 - 7.4.2.5.5 Soluble Chlorides: SM 4500x

7.5 REPORTING: Report of chemical test results shall, as a minimum, contain the following information:

- 7.5.1 Soil constituent analyzed and test method(s) used.
- 7.5.2 Sample location and depth of sample below original ground, or below design pad grade when testing is performed during earthwork operations.
- 7.5.3 Sample description and USCS classification of soil sample before reduction (in accordance with ASTM D2488).
- 7.5.4 Name of person who obtained sample (must be from a CCDDS-BD approved inspector in special inspection item G-T, G-A or an AEC II or above).
- 7.5.5 Test results for each required chemical constituent or property. Test results shall not be numerically reduced to account for any soils excluded from that fraction designated for chemical testing.
- 7.5.6 Chemical test results report must be signed by an approved Analyst, and reviewed & signed by an approved Supervising Analyst or an approved Laboratory Director.

Items **7.5.1**, **7.5.2**, and **7.5.5** are required on the report of chemical test results. Items **7.5.3** and **7.5.4** can be included under a separate heading in QAA reports (pad certification, final grading, etc.).

7.6 CHEMICAL TEST RESULTS-REMEDIAL ACTION PLANS

- 7.6.1 **GENENRAL:** Chemical analyses shall be used to identify adverse soil conditions listed in this section. The geotechnical investigation report shall include specific remedial action plans to address those conditions. The guidelines listed below are minimum requirements. Compliance verification of those remedial measures shall be referenced in Pad Certification reports and shall be detailed in the Final Grading Report.
- 7.6.2 **SULFATE:** Concrete in contact with soil shall comply with the requirements of the current IBC edition at time of permit issuance.
-2000 IBC Table 1904.3
-2006 IBC – ACI 318-05 Table 4.3.1
- 7.6.3 **SOLUBILITY:** Total soluble salts (solubility) shall be determined in accordance with this TG by an AAL. Solubility of foundation soils shall be addressed as follows:
- 7.6.3.1 Solubility, in percent, where “NO ACTION IS REQUIRED” shall be specified by the Geotechnical Engineer of Record. Soils with solubility, in percent, equal to or less than this percentage are arbitrarily designated as soils with negligible solubility or “Non-Soluble Soils.”
- 7.6.3.2 Solubility, in percent, where “BLENDING” of foundation soils with non-soluble soils is required shall be specified by the Geotechnical Engineer of Record. “BLENDING RATIO” of soluble and non-soluble soils AND target solubility of in-place, compacted, blended soils shall be specified. FREQUENCY of solubility verification testing of in-place, compacted, blended soils shall also be specified.
- 7.6.3.3 Solubility, in percent, where complete “REMOVAL & REPLACEMENT” of foundation soils is required shall be specified by the Geotechnical Engineer of Record. Where complete removal and replacement is identified as the remedial measure, vertical and horizontal extent of removal and replacement shall be specified. The Geotechnical Engineer of Record shall provide additional special requirements based upon loading and/or probable post-construction moisture condition variations.
- 7.6.4 **CHEMICAL HEAVE (SALT HEAVE):** Foundation soils susceptible to chemical heave shall be addressed as follows:
- 7.6.4.1 Chemical heave, total soluble salts (in percent), where “NO ACTION IS REQUIRED” shall be specified.
- 7.6.4.2 Chemical heave, total soluble salts (in percent), where a free-draining, thermal blanket of nominal thickness is required below the foundation system shall be specified.
- 7.6.4.3 Chemical heave, total soluble salts (in percent), where complete removal and replacement of foundation soils is required shall be specified. Where complete removal and replacement is identified as the remedial measure, vertical and horizontal extent of removal and replacement shall be specified.
- 7.6.5 **CORROSIVITY:** Corrosion protection of reinforcement and other embedded items is to comply with IBC referenced requirements.

7.7 PERSONNEL APPROVAL REQUIREMENTS:

Minimum approval requirements for personnel engaged in the analysis of chemical properties of soils shall be in accordance with the requirements set forth in TG-17.

8.0 RECORDS:

A Quality Assurance Plan (QAP) shall be submitted by the Analytical Laboratories and approved by CCDDS-BD prior to becoming an Approved Analytical Laboratory. This QAP shall comply with TG-15.

9.0 ATTACHMENTS:

None.

10.0 REVISION HISTORY:

Title	Revision/Approved Date	Effective Date
TG-19-2007	July 6, 2007	July 20, 2007
TG-19-2006	August 14, 2006	August 28, 2006
TG-19-2001	September 17, 2001	October 1, 2001
TG-19-99	June 1, 2000	June 1, 2000